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Importance and Relevance of Circular Economy in the Indian Context

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ABSTRACT

The study dwells upon circular economy (CE), particularly how it gets operationalized at the policy and industry levels. It explores the roots of CE and formalization in ecology and economics. A few developing nations, for example, India, grapple with the difficult mission of environmental pollution, rapid urbanization, climate change, food & water security, etc. Administrators look forward to the importance of resilience at the family, village, urban, corporate, and government levels. Hence, the adoption of CE concepts in a broad manner with potential solutions for innovative pathways in utilizing materials responsibly while reducing and or eliminating waste will be meaningful. Enhancing resource efficiencies and reducing pollution and emissions in an increasingly Competitive Environment (CE) should be driven by both private and public investments in a focused manner. The CE vows and ensures that the values of management advocated by the nation's ancestors which will refocus society while conversing with a CE.

Keywords: *Circular Economy; Climate Change; Environment; Waste; Pollution.*

1.0 Introduction

The essential aspect of CE is to reuse and recycle materials to reduce waste and lower environmental whack, for example, water footprint, air acidification, and carbon footprint. CE enhances product durability through the reuse and recycling of the product and the environmental and economic benefits. CE offers a new perspective that recognizes the need to take a bird's view of products and processes as an economic approach aims at annulling waste and the continual use of resources.

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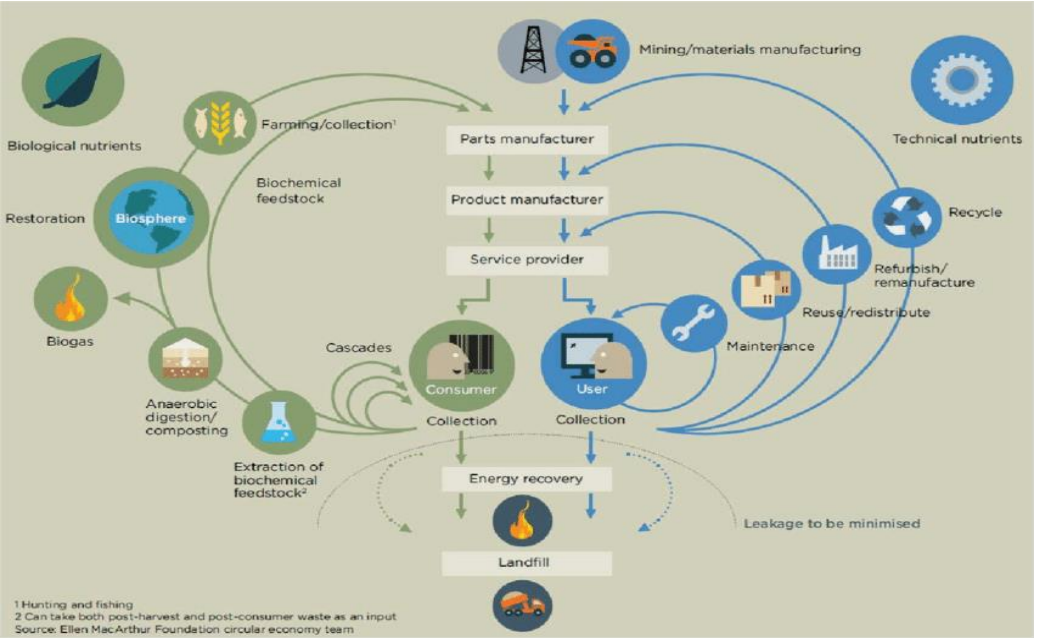
Practices around the principles of CE of our production system should be such that along with reducing resource dependency as it also gains competitive advantage. In economies based on recycling, raw materials that make products culminate in a landfill after use, and such waste materials are reused. It is well-acknowledged that the benefits of CE include (a) Reduced dependence on imported materials by using local resources that also promotes resource independence (b) Consuming fewer natural resources, producing less trash, and lowering emissions helps protect the environment. (c) Shifting production to raw material, the source of which is the reuse of proximate waste that benefits the local economy (d) And while fostering a new and innovative mechanical/automated model that translates into an economic expansion that attracts and drives employment growth (Refer to Figure 1).

Figure 1: Graphical Representation of the Circular Economy



Source: https://www.researchgate.net/figure/Graphical-representation-of-the-circular-economy_ fig5_ 342707922

1.1 Rationale behind the study

A global movement from linear to circular manufacturing is happening of late, a paradigm shift, as awareness about climate change is rising. It is evident developed

nations of the universe are transitioning from linear to CE, India has also charted its growth path of renewing by design and restorative.

India's manufacturing would be constrained with a linear economy model of 'Take-Make-Dispose' as it has only 4 percent of the world's fresh water and 2 percent of the landmass, which eventually will impact the overall economy. Hence, moving towards CE that provides several prongs of ecological and economic benefits is necessary to realize and change the material flow in the manufacturing process.

All types of waste expired electrical appliances, and scrap metal is used wisely or sent back to the economy in CE. To achieve principles that relate to redesigning, recycling, remanufacturing, recovering, and reusing nutrients and water to safeguard natural resources from irresponsible treatment is what the concept of CE and it depends on strategies, practices, technologies, and policies.

Our ability will spur our transition towards self-reliance, a key to an Aatmanirbhar Bharat for sustainable growth by minimizing the consumption of finite resources, maximizing our resource efficiency, and the momentum to the blooming of renewed business blueprint and entrepreneurial undertakings. The paper also discusses teachings on the subject matter necessary for academic and vocational training. It invites the discussion on waste minimization, reutilization, and renewable energy production and establishes the need for better linkages between waste alteration implementation and CE. The paper then discusses the importance of recharging the ground and rainwater harvesting while administering resource use.

1.2 Objectives of the study

Continuing from the introduction and describing the rationale author lists the following objectives.

1. To study the principles of CE and strategies needed to implement while aiming for reducing carbon footprint and waste minimization.
2. To study the benefits of CE for India to achieve its environmental furtherance and continued economic growth, translating into human development.

2.0 Literature Review

Paper (Fiksel *et al.*, 2021) describes Waste Management Innovation to stimulate waste minimization strategies based on circular economy principles. Per Anbumozhi *et al.*, (2016), India has the dynamism to evaluate resource proficiency covering its national economy. The country has set ambitious resource productivity, recycling, and waste reduction targets in the water and energy sectors.

By circular, a providence is forecasted as having no net impact on the surroundings relatively, as it restores any impairment done in resource addition while ensuring lower waste gets produced in every respect of the manufacturing activities and the whole life-cycle of the product (Murray *et al.*, 2017). Per Krishnamurthy *et al.*, (2019), the 3Rs denote and utilized to superscribe waste are recycled, reduced, and reuse. Lowering the quantum of waste reusing is recognizing a new way to utilize waste stuff, and recycling is using waste stuff to remake new materials that get sold or utilized again.

CE demands the industry redesign its processes towards sustainability and includes the 3R philosophy. The CE path set a higher importance on the zero-waste proposition and encompasses green materialism in its theories – Yaduvanshi *et al.*, (2016). Per Geissdoerfer *et al.*, (2017), despite the concept's importance for academia, policymakers, and companies, the conceptual relationship between CE and sustainability is not clear. The CE concept has also gained traction with policymakers, influencing governments and intergovernmental agencies at the local, regional, national, and international levels. Suggestions are being made that the contemporary conceptualization of the CE and its practice has been predominantly advanced by businesses and policy, despite its academic origins (Korhonen *et al.*, 2018). A CE model is "restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times," though no such written material is available throughout the philosophy (MacArthur, 2015 & 2020; Stahel 2016).

Per Kirchherr *et al.*, (2017), the CE is an economic system that replaces the end-of-life concept with recycling, reducing, alternatively reusing, and recovering materials in production, distribution, and consumption processes. It operates at the macro level (city, region, nation, and beyond), micro-level (products, companies, consumers), and Meso-level (eco-industrial parks) with the motif to attain maintainable development, thus concurrently making environmental quality aspects, and economic well-being, and social equity, to the interest of current and future generations.

Schroeder *et al.*, (2019) mention that the CE can espouse straightaway in attaining many of the SDG15 (life on land)), SDG12 (responsible consumption and production), SDG 8 (decent work and economic growth), SDG7 (affordable and clean energy), and SDGS (SDG6 (clean water and sanitation). Recent technological advancements and the emergence of administrative models have made it possible for transitions to CE and low-carbon infrastructure (Paes *et al.*, 2022). Integrating the energy and materials that flow into cities can offer a huge potential through the principles of CE, concentrating on alleviating climate change effects and making more maintainable infrastructure (Ioppolo *et al.*, 2021). Academic research is to create new knowledge and to use existing knowledge. The author acknowledges the research already made and

brings in a few more perspectives while identifying a few areas requiring a focused approach to CE per the objectives defined.

3.0 Research Methodology

3.1 Research design

The article is descriptive, and the author has used secondary data from reliable sources – namely, a few authentic websites that include MoSPI, Government documents, domestic and international online publications, and various industry chambers, academic journals, among others.

3.2 Sources of data

The study has collected data from secondary sources, the data for the study from secondary sources include from databased of Scopus, web of science and googled scholar. Further the data is also collected from the reputed journals and magazine in the domain of manufacturing and industry 4.0.

3.3 Rationale of selection of the study

The paper discusses the importance for the country to subscribe to CE strategically and holistically while considering related aspects to reap its full benefits. Implementing CE will help the nation meet its COP-27 commitment towards reaching Net-Zero by 2070. And it was after the country had updated its Nationally Determined Contributions (NDCs) on 26-Aug-2022 along with a long-term low carbon plan on 14-Nov-2022 and communicated to UNFCCC (PIB, 8-Dec-2022)

4.0 Analysis and Discussion

The plans and strategies encompassing the principle of CE have received worldwide acceptance in a scientific group of late was clear from the results of the Scopus survey as the search hit ‘circular economy’ CE generated the highest number of results. For the conversion towards a low-carbon and less polluting economy, the acceptance of emerging models such as CE principles in environmental administration is one of the policies. The principle of CE is relatively new, although the ideas of CE are closely related to different other economic maintainability paths, for example, mechanical ecology and mechanical harmony, targeting the circularization of linear value chains. A CE aims to redefine expansion and look beyond the take-make-waste-extorting mechanical model while concentrating on positive society-wide benefits.

Consumption of finite resources entails gradually decoupling economic activities and designing waste out of the system. The circular model builds a social, natural, and economic model underpinned by a transition to renewable energy sources. The value proposition is the core component of the circular business model. A product, product-related service, or a pure service gets offered by circular value proposition offers. The offer should enable the consumer/user to do what is required, reduce issues that the consumer/user would experience, and give extra benefits.

Circular products are thus designed to enhance recycling, cascading, and reusing. These require a modular design and choosing materials that allow remanufacturing, reusing, recycling, cascading, or safe disposal (Refer to Figure 3). Hence, these products are 100 percent ready to circulate in the closed material loops. Additionally, product design is required to allow while using less energy or raw material or to minimize emissions. Exploring biomass co-firing potential, developing economies require newer technology and matching policy interventions which may not be maintainable without a unified sectoral interaction. For handling city water, energy systems, and waste, legal structure and cross-sectoral partnerships are crucial to the success of innovative drives. Collaborations between the private sector and the government are also critical for CE drives, for example, Public-Private Partnerships (PPP).

As humans, we are thus obliged to implement CE and ensure that we avoid harming the environment as one part and coexist in the ecosystem. We can start to meet all our current needs without risking future generations' abilities and must do all that is in our power. Along with a significant reduction in congestion and pollution, the CE path adopted by India would reap healthy dividends while reducing pollution and congestion significantly. Spreading of CE principles within management requires substantial efforts, particularly when waste management rules for plastic, e-waste, and municipal lack coordination with CE principles and is renascent with recent times when India seems to have been working towards the achievement of the SDGs. Coordination of waste management and renewable energy plans beneath an aegis CE strategy would provide further momentum - in the achievement of circularity and sustainable development in the Indian economy.

As defined by renewable energy & CE Status Paper, India – "a CE" is a regenerative system in which resource input and waste, emission, and energy leakages are minimized - by reducing, closing, and narrowing material and energy loops. And this is achieved through long-lasting and environmentally sensitive design, requiring lean maintenance, and promoting repair, refurbishing, reuse, remanufacturing, and recycling." To drive the country towards a CE Indian government has been actively promoting

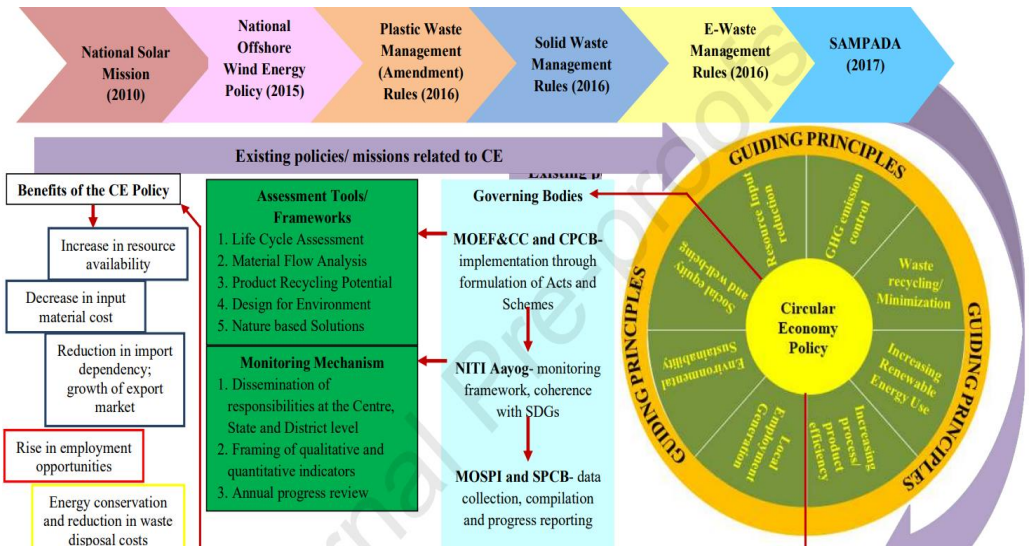
projects and formulating policies (Refer, Figure 2). A few of the various rules those notified are: (a)E-Waste Management Rules (b) Metals Recycling Policy (c) Plastic Waste Management Rules (d) Demolition Waste Management Rules. Per Press Information Bureau, 11 committees were formed to expedite the transition from linear to CE–comprising officials from NITI Aayog, MoEFCC, industry representatives, academics, and domain experts–for 11 focus areas (Table 1).

Table 1: Focused Areas for Transition to Circular Economy

S. No.	Focus Area	Concerned Line Ministry
1	Scrap Metal (Ferrous and Non-ferrous)	Ministry of Steel
2	Solar Panels	MNRE
3	Tyre and Rubber Recycling	Department for Promotion of Industry and Internal Trade
4	Electronic Waste	Ministry of Electronics and Information Technology
5	Agriculture Waste	Ministry of Agriculture & Farmers' Welfare
6	End-of-life Vehicles (ELVs)	Ministry of Road Transport and Highways
7	Used Oil Waste	Ministry of Petroleum and Natural Gas
8	Municipal Solid Waste & Liquid Waste	Ministry of Housing & Urban Affairs
9	Toxic and Hazardous Industrial Waste	Department of Chemicals and Petrochemicals
10	Gypsum	Department for Promotion of Industry and Internal Trade
11	Lithium Ion (Li-ion) Batteries	NITI Aayog

Source: Press Information Bureau (PIB, 18-Mar-2021)

Figure 2: Proposed Framework for a CE Policy for India



Source: www.niti.gov.in

Figure 3: The Circular Economy Model, European Parliament

Source: The Circular Economy Model, European Parliament

Among the local urban bodies, a lack of awareness exists to implement recycling programs, per a few studies. Per analysis of many years of data, a recent approach to CE suggested a resolute recycling agenda. The CE epitomizes the endeavour to conceptualize the integration of environmental well-being and economic activity in a sustainable manner. Considering the related but limited ability of green consumerism to check and restrain urgent eco-issues debate in favour of CE, the overall expansion of consumerism advances to increased waste generation, particularly in Indian urban metros and cities.

Indian automotive sector is striving for by adopting sustainability initiatives, including the CE, although implementation is not up to the mark and varies. One of the reasons identified is a lack of awareness of the roadblocks hindering it. Secondly, the Indian automotive sector gives away monetary benefits of reduced waste, agile production process, lower resource utilisation, etc., and the application of CE. Consequently, the application of CE concepts by Indian automobile companies' ushers to maintainable development and expansion of the Indian economy.

The study by Agrawal *et al.*, (2021) summarised roadblocks in embracing CE concepts in the Indian automotive sector including:

1. A shortfall in the potential to deliver the best quality remanufactured products,
2. Sustaining the design of the reused product,
3. Lack of realization in society, and
4. Absence of consumer knowledge about refurbished products.

Our reliance on technology keeps increasing our electronic waste. Our e-waste has never been this higher even though many items are bought, the shelf life keeps decreasing. Electronic waste cannot get tossed away; it must be disposed of appropriately. Individuals also must make required adjustments to protect the surrounding environment. Past practices in waste management were mainly driven by reducing the costs of collection and disposal — landfill versus recycling (Refer to Figure 1). In a CE, the idea is to increase the value at every incremental point in a product's lifecycle. The conversion to a CE warrants a total directional change across the consumption and production system (Table 2).

Table: 2: Resource Efficiency – Transition to a Circular Economy

Linear	Circular
Competition	Collaboration
Added value	Shared value
Raw materials & waste	Raw materials only
Downcycling	Upcycling
Do less bad	Do good and positive
Standardized production	Local and adapted production
Individuals	Ecosystem

Source: EU-REI Course Materials for Creating a Resource Efficient India

The harmony between different rural and urban activities, through sectors, for example, energy, waste, and water is an essential way of creating CE principles by empowering the conversion of linear flows into a closed loop. Closed-loop material processes can - ameliorate the resource capacity of these processes by lowering material consumption and waste discharge, emanating momentous regional and local environmental and economic benefits.

To establish and maintain relationships and to garner revenue flow, correlate with the principles of the assets required to make, propose, and deliver value propositions via identified channels, guiding the CE in two ways. One focused on regenerating and restoring the natural capital, and the second on input choices. Natural capital restoration and regeneration concerns using energy from land restoration,

reclamation, or renewable sources, saving water, operating in more efficient buildings, and selecting maintainable production locations. for example, eco-parks. To incorporate different aspects and offer a range of concepts that share the idea of closed loops, the recent understanding of the CE and its constructive applications to economic systems and industrial processes have developed. Material loops are the basic idea of the CE. This idea estimates that products, their components, and or materials can be cascaded (in the case of biological nutrients) and redistributed/reused, refurbished /remanufactured, or recycled (in the case of technical nutrients), which demand in advance collecting back from the consumer and reverse logistics (refer to Figure 1).

A CE might turn goods at the final stage of their service life into resources for others, minimizing waste and closing loops in industrial ecosystems. It might change financial reasoning - as it replaces production with sufficient recycle what cannot be reused, repairing what is broken, reusing what you can, and remanufacturing what cannot be repair. CE business models are of two types: Those that convert old goods into as-new resources by recycling the materials; and those that nurture reuse and extend service life by remanufacturing, upgrading, repairing, and retrofitting.

Manufacturing and energy sectors have solid effects and consequences on the maintainability transitions of other sectors. Therefore, CE transitions and energy for knuckling climate change focused on the energy and manufacturing sectors, for example, agriculture and waste. And the interaction of various policies at different governmental levels may result in harmony and increased efficiency of joint actions to withstand climate change.

The harmony and trade-offs between waste streams can forward swaps in the context of urban resources governance. Furthermore, the governance aspects for sustainable development can be attained by productivity encouragement, lowering waste, and waste-to-energy requisitions toward energy conversion. This reduced cost (as and when realized) in the creation of public services is advantageous for the actors involved in the PPP, besides for the local community, as the benefit of reduced cost can be transferred/given to consumers or invested in targeted social projects for water supply for the needy ones. I4 technologies (a German strategic initiative) are expected to accelerate industries toward the development of extraordinary operational competencies and improvement in productivity (Rüßmann *et al.*, 2015; Kamble & Gunasekaran, 2021).

Correcting the maintainable performance goals such as lower resource consumption and gas emission rates I4 technologies set-up will drive the operation of CE, which jointly have immense prospects. I4 was developed to create smart factories using merging technologies such as big data analytics, the Internet of Things (IoT), 3D

printing, augmented reality, cloud computing, and robotic systems to develop cyber-physical type systems.

To encourage CE and maintainable mechanical value creation environment, the composition of the IoT, big data analytics, cyber-physical system, and innovative business structure would play a crucial role.

a) The CE practices remained focused on executing CE policies at the organizational level (single enterprise) at the micro level. Product recycling or reuse, cleaner production, green purchasing/consumption, and eco-design (ED) are the critical aspects of CE practices at the micro level.
b) To attain Common Monetary and environmental benefits, the CE practices at the meso-level use mechanical harmony. To apportion and use the accessible resources productively and competently, at the meso-level, the CE practices are focused on making eco-industrial parks and attracting industries jointly to apportion and use the accessible resources productively and competently.
c) At the macro level, the CE applications augment its boundaries and try to make out how physical resources and materials can be organized and used productively and competently at the territorial or national level.

5.0 Conclusion

The study is limited to a few variables and confined to a limited period. Any restriction to this study and the examination due to the situation outside the reach of one's control is unintended. The larger purpose of the study suggests bearing more learning on these and other CE variables hereafter with supportive data reviews while using both statistical and econometric tests and including more explicit discussion to help yield desirable results.

The above discussion shows that CE implementation affiliating to the recycling of e-waste, human waste, household waste, and sewage sludge will need more efforts imparting skills training and health and safety mean to avert trade-offs with targets for welfare, human health, and safe working surroundings. It appears and observed that CE awareness is centered around large industries and scattered across micro-small–medium enterprises (MSMEs). It requires teachings in academic and vocational training. CE inherently targets expanding accessibility per unit resource uprooted through waste minimization, reutilization, and renewable energy production.

The paper revealed the need for better linkages between waste alteration implementation and CE. It is crucial to recharge the ground by providing materials to organisms and plants while aiming to keep products and resources at a pricey level till it

last by administering resource use. Here rainwater harvesting is crucial both for surface water and rooftop harvesting. Parking and placing components and materials into unrelated usage after life ends through various value streams. To promote the optimal use of resources, CE and renewable energy lower the material inputs by minimizing losses and increasing the material circulation and flow.

Although discrete/single search strings corresponding to renewable energy (81623) and waste management (97475) generated innumerable results, their connection with CE reduced the results significantly. However, the connecting of CE with most parts shaping development such as renewable energy and waste management, besides the policy structure, is still markedly missing. The profound inequalities revealed by Covid-19 and other spill-over disasters show us the significance of sustainable urban development. Bolstering the readiness and adaptability of cities is crucial in countering future crises (per SDG-11 by United Nations). The administrators and regulators must embrace policy moves, with amending taxation, to encourage a CE by businesses. Moreover, the scientific community must scan the ambit for innovations registering it for patent and license, thus paving the further scope for sizeable leaps in breaking-up molecules to recycle atoms. Lastly, administrators and people must join hands in improving resource effectiveness, reducing pollution and waste, and building a new CE (per SDG-12 by United Nations).

The shift to CE needs quite a different approach, beliefs, and value change. Strategies are considered on a life cycle basis to report load moving and harmonize through industrial sectors and life cycle stages. CE is demanding reality, though this paper attempted offering while identifying a few potential barriers, which will be handy for the corporate/ industry desire to proceed. The critical remarks mentioned in the paper are to encourage industrial supervisors to embrace CE practices.

Another contribution of the paper throws light on developing a plan which helps the communities and policymakers recognize the organizers for energy-saving e-waste management in India. Structuring a CE strategy for India would additionally boost renewable energy adding to the achievement of the SDGs.

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